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EXAMINER	
WILLIAMS, LAWRENCE B	

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2638	

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Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/693,171	KETCHUM ET AL.	
	Examiner	**Art Unit**	
	Lawrence B. Williams	2634	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *23 October 2003*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-59* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-8, 11-59* is/are rejected.

7)☒ Claim(s) *9 and 10* is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *23 October 2003* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *7/13/04, 9/3/04*.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application (PTO-152)

6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The specification has not been checked to the extent necessary to determine the presence of all possible minor errors. Applicant's cooperation is requested in correcting any errors of which applicant may become aware in the specification.

Claim Rejections - 35 USC § 102

2. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for a patent.

3. Claims 28-29, 31-39, 45-48 are rejected under 35 U.S.C. 102(a) as being anticipated by Ling et al. (WO02/078211 A2).

(1) With regard to claim 28, Ling et al. discloses in Fig(s) 1-4, an apparatus in a wireless time division duplexed (TDD) multiple-input multiple-output communication system, comprising: means (Fig. 2B, elements 120b, 212) for processing a MIMO pilot received via a first link to obtain a plurality of eigenvectors usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link (pg. 12, paragraph [1042-1043]), wherein the MIMO pilot comprises a plurality of pilot transmissions sent from a plurality of transmit antennas, and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIM0 pilot (pg. 13, paragraph [1047]). CSI information is disclosed as eigenvalues and eigenmodes for the plurality of transmission

channels. It would be inherent that the pilot transmission from each transmit antenna be identifiable by a receiver of the pilot); means (Fig. 3, element 312A) for performing spatial processing on a first data transmission received via the first link with the plurality of eigenvectors to recover data symbols for the first data transmission; and means (Fig. 3, element 314L) for performing spatial processing for a second data transmission with the plurality of eigenvectors prior to transmission over the second link.

(2) With regard to claim 29, Ling et al. also discloses the apparatus of claim 28, further comprising: means (Fig. 1, element 162) for performing spatial processing on pilot symbols with at least one of the eigenvectors to generate a steered pilot for transmission on at least one eigenmode of a MIMO channel for the second link

(3) With regard to claim 31, Ling et al. discloses in Fig(s) 1-6, an apparatus in a wireless time division duplexed TDD multiple-input multiple-output (MIMO) communication system, comprising: a controller (Fig. 5, element 530) operative to process a MIMO pilot received via a first link to obtain a plurality of eigenvectors usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link, wherein the MIMO pilot comprises a plurality of pilot transmissions sent from a plurality of transmit antennas (full CSI, pg. 6, paragraph [1026]), and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot; a receive spatial processing (Fig. 1, element 158) operative to perform spatial processing on a first data transmission received via the first link with the plurality of eigenvectors to recover data symbols for the first data transmission; and a transmit spatial processor (Fig. 1, element 162) operative to perform spatial

processing for a second data transmission with the plurality of eigenvectors prior to transmission over the second link.

(4) With regard to claim 32, Ling et al. also discloses the apparatus of claim 31, wherein the transmit spatial processor is further operative to perform spatial processing on pilot symbols with at least one of the eigenvectors to generate a steered pilot for transmission on at least one eigenmode of a MIMO channel for the second link (pg. 12, paragraph [1042]).

(5) With regard to claim 34, Ling et al. teaches a method of performing spatial processing in a wireless time division duplexed (TDD) multiple-input multiple-output (MIMO) communication system, comprising: processing a steered pilot (modulation symbol streams) received via at least one eigenmode of a MIMO channel for a first link to obtain at least one eigenvector usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link (pg. 12, paragraph [1042]); performing spatial processing on a first data transmission received via the first link with the at least one eigenvector; and performing spatial processing for a second data transmission with the at least one eigenvector prior to transmission over the second link (Fig 4, Subchannel MIMO Processor, 412X-A-K).

(6) With regard to claim 35, Ling et al. also discloses in Fig(s) 4, 6, the method of claim 34, further comprising: generating a MIMO pilot for transmission over the second link, wherein the MIMO pilot comprises a plurality of pilot transmissions sent from a plurality of transmit antennas [1042], and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot. Figures 6 shows multiple demodulators (154A- 154R) and circuitry (156A) used identify each pilot transmission.

(7) With regard to claim 36, Ling et al. also discloses an apparatus in a wireless time division duplexed (TDD) multiple-input multiple-output (M1M0) communication system, comprising: means (Fig. 2B, elements 120b, 212) for processing a steered pilot (modulation symbol stream) received via at least one eigenmode of a MIMO channel for a first link to obtain at least one eigenvector usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link; means (Fig. 4, element 412X) for performing spatial processing on a first data transmission received via the first link with the at least one eigenvector, and means (Fig. 4, element 412A) for performing spatial processing for a second data transmission with the at least one eigenvector prior to transmission over the second link.

(8) With regard to claim 37, Ling et al. also discloses the apparatus of claim 36, further comprising means (Fig. 1 element 132) for generating a MIMO pilot for transmission over the second link, wherein the MIMO pilot comprises a plurality of pilot transmissions sent from a plurality of transmit antennas (Full CSI, pg. 12, paragraph [1026]), and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot. Figures 6 shows multiple demodulators (154A- 154R) and circuitry (156A) used to identify each pilot transmission.

(9) With regard to claim 38, Ling et al. discloses in Fig(s) 1, 5, an apparatus in a wireless time division duplexed (TDD) multiple-input multiple-output (MIMO) communication system, comprising: a controller (Fig. 5, element 530) operative to process a steered pilot received via at least one eigenmode of a MIMO channel for a first link to obtain at least one eigenvector usable for spatial processing for both data transmission received via the first link and data

transmission sent via a second link; a receive spatial processor (Fig. 1, element 132) operative to perform spatial processing on a first data transmission received via the first link with the at least one eigenvector; and a transmit spatial processor (Fig. 1, element 120) operative to perform spatial processing for a second data transmission with the at least one eigenvector prior to transmission over the second link (pg. 12, paragraph [1042]).

(10) With regard to claim 39, Ling et al. also discloses the apparatus of claim 38, wherein the transmit spatial processor is further operative to generate a MIMO pilot for transmission over the second link, wherein the MIMO pilot comprises a plurality of pilot transmissions sent from a plurality of transmit antennas (Full CSI, pg. 6, paragraph [1026]), and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot. Figures 6 shows multiple demodulators (154A- 154R) and circuitry (156A) used to identify each pilot transmission.

(11) With regard to claim 45, Ling et al. discloses a method of estimating a wireless channel in a time division duplexed (TDD) multiple-input multiple-output (M1M0) communication system, comprising: processing a pilot transmission received via a first link to obtain a channel response estimate for the first link (pg. 9, paragraph [1035]); and decomposing the channel response estimate to obtain a matrix of eigenvectors usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link (pg. 12, paragraph [1042]; pg(s). 26-27, paragraphs [1089-1093]).

(12) With regard to claim 46, Ling et al. also discloses a method of estimating a wireless channel in a time division duplexed (TDD) multiple-input multiple-output (MIMO) communication system, comprising: receiving a steered pilot (modulation symbols) on at least

one eigenmode of a MIMO channel for a first link; and processing the received steered pilot to obtain at least one eigenvector usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link [(pg. 12, paragraph [1042]).

(13) With regard to claim 47, Ling et al. also discloses the method of claim 46, wherein the processing includes demodulating the received steered pilot to remove modulation due to pilot symbols used to generate the steered pilot, and processing the demodulated steered pilot to obtain the at least one eigenvector (pg.(s) 26-27, paragraphs [1089-1093]).

(14) With regard to claim 48, Ling et al. also discloses the method of claim 46, wherein the at least one eigenvector is obtained based on a minimum mean square error (MMSE) technique (pg. 2, paragraph [1008]). CSI is disclosed as eigenmodes and eigenvalues for the plurality of transmission bands (pg. 12, paragraph [1042]).

Claim Rejections - 35 USC § 102

4. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

> A person shall be entitled to a patent unless –
>
> (e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

5. Claims 50 - 59 are rejected under 35 U.S.C. 102(e) as being anticipated by Lindskog et al. (US Patent 6,738,020 B1).

(1) With regard to claim 50, Lindskog et al. discloses a method for performing data processing in a wireless communication system including an access point and a user terminal, the

method comprising: calibrating one or more communication links including a first link and a second link between the access point and the user terminal to form a calibrated first link and a calibrated second link (col. 2, lines 51-67); obtaining a channel response estimate for the calibrated first link based on one or more pilots transmitted on the calibrated first link (col. 6, lines 8-15); and decomposing the channel response estimate to obtain one or more eigenvectors usable for spatial processing of the one or more communication links (col. 10, lines 23-34).

(2) With regard to claim 51, Lindskog et al. also discloses the method of claim 50 wherein calibrating comprises: determining one or more sets of correction factors based on estimates of channel responses for the one or more communication links; and applying the one or more sets of correction factors to the first and second links to form the calibrated first and second links (col. 10, lines 35-50).

(3) With regard to claim 52 Lindskog et al. also discloses the method of claim 50 further comprising: performing spatial processing for data transmissions on the first and second links using the one or more eigenvectors obtained from decomposing the channel response estimate for the calibrated first link (col. 10, lines 23-34).

(4) With regard to claim 53, Ling et al. also discloses the method of claim 52 wherein performing spatial processing comprises: transmitting a steered reference on the second link using the one or more eigenvectors (pg. 14, paragraph [1053], "transmission symbol for a specific transmit antenna").

(5) With regard to claim 54, Ling et al. also discloses the method of claim 53 further comprising: performing spatial processing on or more pilot symbols with the one or more eigenvectors to generate the steered reference (pg. 12, paragraph [1042]).

(6) With regard to claim 55, claim 55 inherits the limitations of claim 50 above as claim 54 discloses the means for the method of clam 50. Lindskog et al. discloses in Fig(s) 1-3, an apparatus for performing data processing in a wireless communication system including an access point and a user terminal, the apparatus comprising: means for calibrating one or more communication links including a first link and a second link between the access point and the user terminal to form a calibrated first link and a calibrated second link; means for obtaining a channel response estimate for the calibrated first link based on one or more pilots transmitted on the calibrated first link; and means for decomposing the channel response estimate to obtain one or more eigenvectors usable for spatial processing of the one or more communication links. Though Lindskog et al. is not too specific as to individual means, he does teach method and apparatus that allows for system calibration incorporated into a single function. The means would be inherent to the invention.

(7) With regard to claim 56, Lindskog et al. also discloses the apparatus of claim 55 wherein calibrating comprises: means for determining one or more sets of correction factors based on estimates of channel responses for the one or more communication links; and means for applying the one or more sets of correction factors to the first and second links to form the calibrated first and second links. Though Lindskog et al. is not too specific as to individual means, he does teach method and apparatus that allows for system calibration incorporated into a single function. The means would be inherent to the invention.

(8) With regard to claim 57, Lindskog et al. also discloses the apparatus of claim 55 further comprising: performing spatial processing for data transmissions on the first and second links using the one or more eigenvectors obtained from decomposing the channel response

estimate for the calibrated first link. Though Lindskog et al. is not too specific as to individual means, he does teach method and apparatus that allows for system calibration incorporated into a single function. The means would be inherent to the invention.

(9) With regard to claim 58, Ling et al. also discloses the apparatus of claim 57 wherein performing spatial processing comprises: transmitting a steered reference on the second link using the one or more eigenvectors (pg. 14, paragraph [1053], "transmission symbol for a specific transmit antenna").

(10) With regard to claim 59, Ling et al. also discloses the apparatus of claim 58 further comprising: performing spatial processing on or more pilot symbols with the one or more eigenvectors to generate the steered reference (pg. 12, paragraph [1042]).

Claim Rejections - 35 USC § 103

6. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

7. Claims 1-5, 7-8, 11, 13-23 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (WO 02/078211 A2) in view of Raleigh et al. (US Patent 6,452,981 B1).

(1) With regard to claim 1, Ling et al. discloses a method of performing spatial processing in a wireless time division duplexed (TDD) multiple-input multiple-output (MIMO) communication system (pg. 2, paragraph [1007]), comprising: processing a first transmission received via a first link to obtain at least one eigenvector (pg. 12, paragraph [1042]) usable for

spatial processing for both data transmission received via the first link and data transmission sent via a second link (Ling et discloses subchannels 1-N_{Nc}).

Ling et al. does not explicitly disclose performing spatial processing for a second transmission with the at least one eigenvector prior to transmission over the second link. However, Raleigh et al. teaches that wireless links are bidirectional and in systems employing TDD, the receive and transmit propagation environments may be the same. Therefore, one could apply the same eigenvector for spatial processing over the second link.

It would have been obvious to one skilled in the art at the time of invention to incorporate the teachings Raleigh et al. with the invention of Ling et al. as a known method of performing spatial processing to reduce radiated interference (col. 2, lines 37-43).

(2) With regard to claim 2, Ling et al. also discloses the method of claim 1, further comprising: performing spatial processing on a third transmission received via the first link with the at least one eigenvector to recover data symbols for the third transmission. Ling teaches computing of an eigenvector matrix for processing subchannels 1-1-N_{Nc} from multiple transmit antennas [1042].

(3) With regard to claim 3, Ling et al. also teaches method of claim 1, wherein the first transmission is a steered pilot received on at least one eigenmode of MIMO channel for the first link (pg. 6, paragraph [1027], pg. 18, paragraph [1068]). Ling et al. teaches the transmitter computing eigenmodes for the MIMO channel (pg. 6, paragraph [1027]) and teaches deriving a channel coefficient matrix from pilot symbols. It would be inherent and well known to one skilled in the art to use a steered pilot in the first transmission link to determine channel characteristics.

(4) With regard to claim 4, Raleigh et al. teaches the method of claim 1, wherein the first transmission is a MIMO pilot comprised of a plurality of pilot transmissions sent from a plurality of transmit antennas, and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot (col. 31, lines 24-52). Raleigh et al. teaches identification of the MIMO channel by sending a plurality of training bins (pilots) from a plurality of transmitting antennas as a well known method of channel identification in order to determine an appropriate channel vector for each channel. The respective channel vector is then used to determine a respective RSW weight.

(5) With regard to claim 5, Ling et al. also discloses the method of claim 4, wherein the processing a first transmission includes obtaining a channel response estimate (CSI) for the first link based on the MIMO pilot, and decomposing the channel response estimate to obtain a plurality of eigenvectors usable for spatial processing for the first and second links (pg. 27, paragraph [1094]).

(6) With regard to claim 6, Raleigh et al. also discloses the method of claim 5, wherein the channel response estimate for the first link is decomposed using singular value decomposition (col. 17, lines 16-28) as a well known method of diagonalizing an MIMO channel used to reduce interference between data streams.

(7) With regard to claim 7, Ling et al. also discloses the method of claim 4, further comprising: performing spatial processing on pilot symbols (pg. 9, paragraph [1035]) with the at least one eigenvector to generate a steered pilot for transmission on at least one eigenmode of a MIMO channel for the second link (pg. 9, paragraph [1027]).

(8) With regard to claim 8, Ling et al. also discloses the method of claim 1, wherein the second transmission is spatially processed with one eigenvector for transmission on one eigenmode of a MIMO channel for the second link (pg. 6, paragraph [1027]).

(9) With regard to claim 11, Raleigh et al. discloses the method of claim. 1, further comprising: calibrating the first and second links such that a channel response estimate for the first link is reciprocal of a channel response estimate for the second link for matching in the amplitude and phase response of between the transmitter and receiver (col. 29, lines 48-63).

(10) With regard to claim 13, Ling et al. also discloses the method of claim 1, wherein the TDD MIMO communication system utilizes orthogonal frequency division multiplexing (OFDM), and wherein the processing for the first transmission and the spatial processing for the second transmission are performed for each of a plurality of subbands (pg. 17, paragraph [1064]).

(11) With regard to claim 14, Ling et al. discloses in Fig. 2B, 3, 4, an apparatus in a wireless time division duplexed (TDD) multiple-input multiple-output (M1MO) communication system, comprising: means for processing a first transmission (Fig. 2B, element 212) received via a first link to obtain at least one eigenvector usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link; and means for performing (Fig. 3, element 312A) spatial processing for a second transmission with the at least one eigenvector prior to transmission over the second link.

(12) With regard to claim 15, Ling et al. also discloses the apparatus of claim 14, further comprising: means (Fig. 3, element 312L) for performing spatial processing on a third

transmission received via the first link with the at least one eigenvector to recover data symbols for the third transmission.

(13) With regard to claim 16, Ling et al. also teaches the apparatus of claim 14, wherein the first transmission is a steered pilot received on at least one eigenmode of MIMO channel for the first link (pg. 6, paragraph [1027], pg. 18, paragraph [1068]). Ling et al. teaches the transmitter computing eigenmodes for the MIMO channel (pg. 6, paragraph [1027]) and teaches deriving a channel coefficient matrix from pilot symbols. It would be inherent and well known to one skilled in the art to use a steered pilot in the first transmission link to determine channel characteristics.

(14) With regard to claim 17, Raleigh et al. teaches the apparatus of claim 14, wherein the first transmission is a MIMO pilot comprised of a plurality of pilot transmissions sent from a plurality of transmit antennas, and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot (col. 31, lines 24-52). Raleigh et al. teaches identification of the MIMO channel by sending a plurality of training bins (pilots) from a plurality of transmitting antennas as a well-known method of channel identification in order to determine an appropriate channel vector for each channel. The respective channel vector is then used to determine a respective RSW weight.

(15) With regard to claim 18, Ling et al. also discloses in Fig. 5, the apparatus of claim 17, further comprising means (522) for obtaining a channel response estimate for the first link based on the MIMO pilot, and means (524) for decomposing the channel response estimate to obtain a plurality of eigenvectors usable for spatial processing for the first and second links [1094].

(16) With regard to claim 19, Ling et al. also discloses in Fig. 5, 2B, an apparatus in a wireless time division duplexed (TDD) multiple-input multiple-output (MIMO) communication system, comprising: a controller (Fig. 5, element 530) operative to process a first transmission received via a first link to obtain at least one eigenvector usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link; and a transmit spatial processor (Fig. 2B, element 212) operative to perform spatial processing for a second transmission with the at least one eigenvector prior to transmission over the second link.

(17) With regard to claim 20, Ling et al. also discloses in Fig. 5, the apparatus of claim 19, further comprising: a receive spatial processor (156A) operative to perform spatial processing on a third transmission received via the first link with the at least one eigenvector to recover data symbols for the third transmission.

(18) With regard to claim 21, Ling et al. also teaches the apparatus of claim 19, wherein the first transmission is a steered pilot received on at least one eigenmode of MIMO channel for the first link (pg. 6, paragraph [1027, pg. 18, paragraph 1068]). Ling et al. teaches the transmitter computing eigenmodes for the MIMO channel (pg. 6, paragraph [1027]) and teaches deriving a channel coefficient matrix from pilot symbols. It would be inherent and well known to one skilled in the art to use a steered pilot in the first transmission link to determine channel characteristics.

(19) With regard to claim 22, Raleigh et al. teaches the apparatus of claim 14, wherein the first transmission is a MIMO pilot comprised of a plurality of pilot transmissions sent from a plurality of transmit antennas, and wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot (col. 31, lines 24-52). Raleigh et al. teaches

identification of the MIMO channel by sending a plurality of training bins (pilots) from a plurality of transmitting antennas as a well-known method of channel identification in order to determine an appropriate channel vector for each channel. The respective channel vector is then used to determine a respective RSW weight.

(20) With regard to claim 23, Ling et al. also discloses in Fig. 5, the apparatus of claim 22, wherein the controller is further operative comprising for obtaining a channel response estimate for the first link based on the MIMO pilot, and for decomposing the channel response estimate to obtain a plurality of eigenvectors usable for spatial processing for the first and second links (pg. 21, paragraph [1077]).

8. Claim 12 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (WO 02/078211 A2) in view of Raleigh et al. (US Patent 6,452,981 B1) as applied to claim 11 above, and further in view of Boros et al. (US Patent 6,668,161 B2).

As noted above, Ling et al. in combination with Raleigh et al. disclose all limitations of claim 11 above. They do not however disclose the method of claim the method of claim 11, wherein the calibrating includes obtaining correction factors for the first link based on the channel response estimates for the first and second links, and obtaining correction factors for the second link based on the channel response estimates for the first and second links.

However Boros et al. discloses the method of claim 11, wherein the calibrating includes obtaining correction factors for the first link based on the channel response estimates for the first and second links, and obtaining correction factors for the second link based on the channel response estimates for the first and second links (col. 33, lines 47-55).

It would have been obvious to one skilled in the art at the time of invention to apply the method as taught by Boros et al. to the invention as taught by Ling et al. in combination with Raleigh et al. as a method for signal estimation to account for differences in the RF paths (col. 8, lines 28-40).

9. Claims 24-27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (WO 02/078211 A2) in view of Raleigh et al. (US Patent 6,452,981 B1).

(1) With regard to claim 24, Ling et al. discloses a method of performing spatial processing in a wireless time division duplexed (TDD) multiple-input multiple-output (MIMO) communication system, comprising: processing a MIMO pilot received via a first link to obtain a plurality of eigenvectors usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link (pg. 12, paragraph [1042]), wherein the MIMO pilot comprises a plurality of pilot transmissions (pg. 9, paragraph [1035]; pg. 12, paragraph [1043], preconditioned modulation symbol) sent from a plurality of transmit antennas, and; performing spatial processing on a first data transmission received via the first link with the plurality of eigenvectors to recover data symbols for the first data transmission; and performing spatial processing for a second data transmission with the plurality of eigenvectors prior to transmission over the second link (pg. 13, paragraphs [1045-1047], pg. 17, paragraph [1065]).

Ling et al. does not explicitly teach wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot.

However, Raleigh et al. discloses wherein the pilot transmission from each transmit antenna is identifiable by a receiver of the MIMO pilot (col. 31, lines 24-52). Ling et al. teaches identification of the MIMO channel by sending a plurality of training bins (pilots) from a plurality of transmitting antennas.

It would have been obvious to one skilled in the art at the time of invention to incorporate the teachings of Raleigh et al. with the invention of Ling et al. in order to determine an appropriate channel vector for each channel. The respective channel vector is then used to determine a respective channel RSW weight.

(2) With regard to claim 25, Ling et al. also discloses the method of claim 24, further comprising: performing spatial processing on pilot symbols with at least one of the eigenvectors to generate a steered pilot for transmission on at least one eigenmode of a MIMO channel for the second link (pg. 12, paragraph [1042]).

(3) With regard to claim 26, Raleigh et al. also discloses the method of claim 24, further comprising: performing calibration to obtain correction factors; and scaling the second data transmission with the correction factors prior to transmission over the second link (col. 29, line 48 - col. 30, line 10). Raleigh et al. teaches the need for calibration between the up link and downlink. Though he does not explicitly teach scaling the second data transmission with correction factors, it would be obvious to one skilled in the art since calibration techniques and their use are well known in the art as disclosed by Raleigh et al.

(4) With regard to claim 27, Ling et al. also discloses in Fig. 4, the method of claim 24, wherein the TDD MIMO communication system utilizes orthogonal frequency division

multiplexing (OFDM), and wherein the spatial processing is performed for each of a plurality of subbands (pg. 13 paragraphs [1045, 1046]).

10. Claims 30, 33 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (WO 02/078211 A2) as applied to claim 28, above and further in view of Raleigh et al. (US Patent 6,452,981 B1).

(1) With regard to claim 30, as noted above, Ling et al. discloses all limitations of claim 28. Ling et al. does not explicitly teach the apparatus of claim 28, further comprising: means for performing calibration to obtain correction factors, and means for scaling the second data transmission with the correction factors prior to transmission over the second link.

However, Raleigh et al. teaches the need for calibration between the up link and downlink (col. 29, line 48 - col. 30, line 10). Though he does not explicitly teach the means for performing the calibration and scaling, incorporating means for calibration and scaling would be inherent in the design to one skilled in the art to apply the method as taught by Raleigh et al.

(2) With regard to claim 33, Ling et al. does not explicitly teach the apparatus of claim 31, wherein the controller is further operative to perform calibration to obtain correction factors, and wherein the transmit spatial processor is further operative to scale the second data transmission with the correction factors prior to transmission over the second link. Raleigh et al. teaches the need for calibration between the up link and downlink (col. 29, line 48 - col. 30, line 10). Though he does not explicitly teach a controller for performing the calibration and the transmit spatial processor for scaling, incorporating means for calibration and scaling would be inherent in the design to one skilled in the art to apply the method as taught by Raleigh et al.

11. Claim 42 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (WO 02/078211 A2) in view of Raleigh et al. (US Patent 6,452,981 B1).

Ling et al. discloses a method of performing spatial processing in a wireless time division duplexed (TDD) multiple-input multiple-output (MIMO) communication system (pg. 2, paragraph [1007]), comprising: processing a first transmission received via a first link to obtain a matrix of eigenvectors (pg. 12, paragraph [0042]) for each of a plurality of subbands, wherein a plurality of matrices of eigenvectors are obtained for the plurality of subbands and are used at least one eigenvector (pg. 12, paragraph [1042]) usable for spatial processing for both data transmission received via the first link and data transmission sent via a second link (Ling et al. discloses subchannels 1-N_{Nc}).

Ling et al. does not explicitly disclose performing spatial processing for a second transmission with the plurality of matrices of eigenvectors prior to transmission over the second link. However, Raleigh et al. teaches that wireless links are bidirectional and in systems employing TDD, the receive and transmit propagation environments may be the same (col. 29, lines 47-51). Therefore, one could apply the same eigenvector for spatial processing over the second link.

It would have been obvious to one skilled in the art at the time of invention to incorporate the teachings of Raleigh et al. with the invention of Ling et al. as a known method of performing spatial processing to reduce radiated interference (col. 2, lines 37-43).

12. Claim 49 is rejected under 35 U.S.C. 103(a) as being unpatentable over Ling et al. (WO 02/078211 A2) as applied to claim 46 above, and further in view of Schmidl et al. (US 2002/0034263 A1).

As noted above, Ling et al. discloses all limitations of claim 46. Ling et al. does not however disclose the method of claim 46, wherein a plurality of eigenvectors are obtained and are forced to be orthogonal to one another.

However, Schmidl et al. teaches wherein a plurality of eigenvectors are obtained and are forced to be orthogonal to one another [0013].

It would have been obvious to incorporate the teaching of Schmidt with the invention of Ling et al. in order to implement a receiver with a matched filter for each eigenvector [0013].

Allowable Subject Matter

13. Claim 9, 10 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

a.) Boros et al. discloses in US 2003/0050016 A1 Periodic Calibration On A Communications Channel.

b.) Boros et al. discloses in US 2002/0155818 A1 Determining A spatial Signature Using A Robust Calibration signal.

c.) Sampath discloses in US 2003/0043929 A1 Transmit Signal Preprocessing Based On Transmit Antennae Correlations For Multiple Antennae Systems.

d.) Raleigh et al. discloses in US Patent 6,888,899 B2 Spatio-Temporal Processing For Communication.

e.) Agee et al. discloses in US 2004/0095907 A1 Method And Apparatus For Optimization Of Wireless Multipoint Electromagnetic Communication Networks.

f.) Walton et al. discloses in US 2002/0154705 A1 High Efficiency High Performance Communications System Employing Multi-Carrier Modulation.

g.) Ketchum et al. discloses in US 2004/0087324 A1 Channel Estimation And Spatial Processing For TDD MIMO Systems.

h.) Ketchum et al. discloses in US 2004/0179627 A1 Pilots For MIMO Communication Systems.

i.) Walton et al. discloses in US 2005/0111599 A1 Multi-Antenna Transmission For Spatial-Division Multiple Access.

j.) Walton et al. discloses in US 2004/0082356 A1 MIMO WLAN System.

15. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Lawrence B Williams whose telephone number is 571-272-3037. The examiner can normally be reached on Monday-Friday (8:00-5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kenneth Vanderpuye can be reached on 571-272-3078. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Lawrence B. Williams

lbw
July 22, 2005

EMMANUEL BAYARD
PRIMARY EXAMINER